

NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE STANDARD

**DEEP TILLAGE**

(Acres)

**CODE 324**

**DEFINITION**

Performing tillage operations below the normal tillage depth to modify the physical or chemical properties of a soil.

**PURPOSES**

This practice may be applied as part of a conservation management system to support one or more of the following:

- Fracture restrictive soil layers.
- Bury or mix soil deposits from wind or water erosion or flood overwash.
- Reduce concentration of soil contaminants, which inhibit plant growth.
- Mix stratified soil layers

**CONDITIONS WHERE PRACTICE APPLIES**

This practice applies to land having adverse soil conditions which inhibit plant growth, such as compacted layers formed by field operations, stratified soil layers, restrictive layers such as claypans, overwash, or deposits from wind and water erosion or flooding, or contaminants in the root zone.

This standard includes tillage operations commonly referred to as deep plowing, slip plowing, subsoiling, ripping, or row-till, performed from time to time below the normal tillage depth.

**CRITERIA**

**General Criteria Applicable to All Purposes**

Deep tillage operations shall be performed when soil moisture is less than 30 percent of field capacity, according to the “feel test” or other acceptable method, at the maximum depth to which

the tillage will be done.

**Additional Criteria to Fracture Restrictive Soil Layers**

Tillage equipment such as chisels, subsoilers, bent-leg subsoilers, or rippers, with the ability to reach the required depth shall be used.

Adjust the depth and spacing so the implement penetrates and shatters or mixes the restrictive layer over 70 percent of the area between implement penetration points.

The depth of tillage shall be a minimum of one inch deeper than the depth of the restrictive layer. Tillage depth should be set carefully and periodically checked to maintain this working depth.

**Additional Criteria to Bury or Mix Soil Deposits from Wind and Water Erosion or Flood Overwash**

Tillage equipment such as moldboard plows disk plows or chisels with twisted points, with the ability to reach the required depth shall be used.

The tillage operation shall uniformly mix soil 6" or 2 times (2 X) the depth of overwash, whichever is deeper, to achieve a desired available water-holding capacity (AWC) and to break the hydrologic barrier caused by overwash layer.

**Additional Criteria to Reduce Concentration of Soil Contaminants Which Inhibit Plant Growth**

Tillage equipment such as moldboard plows, disk plows or chisels with twisted points, with the ability to reach the required depth shall be used.

In the case of non-irrigated soils or slightly mobile contaminants, the tillage operation shall mix a sufficient amount of uncontaminated soil with the contaminated material so that the

concentration of the contaminant is below the crop tolerance level. Crop tolerance levels shall be established in accordance with University of California publication “Agricultural Salinity and Drainage, UC Irrigation Program, 1993”, or equivalent. The soil contaminant shall be uniformly distributed throughout the deep tilled layer.

For irrigated soils with mobile contaminants, contaminants should be managed with irrigation where possible. Refer to Practice 610 “Toxic Salt Removal”.

#### **Additional Criteria to Mix Stratified Soils**

Slip plows should be set deep enough to mix all layers to the depth necessary to allow full root development and adequate percolation for irrigation and drainage. Where drainage restrictions arise from multiple sources evaluate field conditions to determine the likelihood of desired benefits before using deep tillage.

#### **CONSIDERATIONS**

This practice is not recommended as a routine action unless the specific field in question is known to require treatment. Effort should be made to determine the appropriate frequency of this practice for increasing water penetration. Review tillage and other practices if this must be done annually.

Where restrictive layers are a concern, the effects of this practice can be enhanced by including deep rooted crops in the rotation that are able to extend to and penetrate the restrictive layer.

When infertile flood overwash is mixed with the pre-flood soil profile, the soil rebuilding process can be enhanced by additions of organic matter, such as manure or cover crops utilized as green manure. Crop rotations, tillage and planting systems, which maintain high levels of crop residues, such as no-till, can also accelerate this process.

Where the flood overwash layer is too thick to effectively mix with the pre-flood soil profile, redistribution of the overwash layer by smoothing or removal may be necessary. Generally, no more than about 6 inches of overwash can be uniformly mixed into the soil profile using commonly available equipment. Specialized equipment may be necessary where greater depths of overwash are to be incorporated.

Where unfavorable soil materials such as high sodium, calcium, gypsum or other undesirable materials, are within anticipated deep tillage depth and would be brought to the surface by deep tillage operations, this practice should not be applied.

To help reduce compaction, it is desirable to conduct normal tillage operations when soil moisture is less than 50 percent of field capacity. When possible harvest operations should be avoided when soil moisture is greater than 50 percent of field capacity. Field harvest haul traffic should be limited to end rows or haul roads.

If application of this practice will impact cultural resources (Archaeological, historic, historic landscape, or traditional cultural properties), follow NRCS national policy and State operating procedures for considering cultural resources.

Before subsoiling, check field in several places with an auger or backhoe to determine bottom depth or restrictive layer and if the layer(s) are sufficiently dry to shatter. Silty materials should be hard, dry and cloddy and will crush down into a powdery condition. Clayey layers should be hard and naturally cracked.

If field will be leveled for irrigation, subsoil areas to be deeply filled before making the fills.

Special deep plows are also available that will mix soil layers down to 36 to 48 inch depths.

The slip plow functions as a subsoiler and penetrates down to 48 to 60 inch depths.

## Cultural Resources Considerations

Determine if installation of this practice with any others proposed will have any effect on any cultural resources. NRCS's objective is to avoid any effect to cultural resources and protect them in their original location. GM 420, Part 401, the California Environmental Handbook and the training for the California Environmental Assessment Worksheet specify how the NRCS must account for cultural resources. The Field Office Technical Guide, Section II contains general information, with Web sites for additional information, about cultural resources. The Environmental Handbook is online at [www.ca.nrcs.usda.gov/rts/rts.html](http://www.ca.nrcs.usda.gov/rts/rts.html).

## Endangered Species Considerations

Determine if installation of this practice with any others proposed will have any effect on any federal or state listed Rare, Threatened or Endangered species or their habitat. NRCS's objective is to benefit these species and others of concern or at least not have any adverse effect on a listed species. If the Environmental Evaluation indicates the action may adversely affect a listed species or result in adverse modification of habitat of listed species which has been determined to be critical habitat, NRCS will advise the land user of the requirements of the Endangered Species Act and recommend alternative conservation treatments that avoid the adverse effects. Further assistance will be provided only if the landowner selects one of the alternative conservation treatments for installation; or at the request of the landowners, NRCS may initiate consultation with the Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game. If the Environmental Evaluation indicates the action will not affect a listed species or result in adverse modification of critical habitat, consultation generally will not apply and usually would not be initiated. Document any special considerations for endangered species in the Practice Requirements Worksheet.

Some species are year-round residents in some streams, such as, freshwater shrimp. Other species, such as steelhead and salmon, utilize streams during various seasons. Be aware that during critical periods, such as spawning, eggs in gravels, and rearing of young may preclude activities in the stream that may directly affect the stream habitat

during those periods. For example there should be no disturbance of stream gravel beds that may have eggs in them. That could include any equipment in the stream or even walking in the stream or work upstream that may result in sediment depositing in the gravel beds. Document any special considerations for endangered species in the Practice Requirements Worksheet.

## Water Quantity

The practice significantly decreases runoff, increases infiltration by mechanically shattering restrictive layers in the soil. The soil's ability to store water is increased and there is more rooting area increasing the potential for evapotranspiration. The amount of surface runoff is reduced. Water storage in a chiseled field may be increased 3 1/2 times more than in a nonchiseled field. This may need to be an annual practice to obtain the maximum benefits for water resources. If soil and moisture conditions allow percolation of infiltration waters below the root zone, ground water recharge may occur.

1. Effects on the water budget components, especially on volumes and rates of runoff and infiltration.
2. Variability of the practices effects caused by seasonal weather variations.

## Water Quality

Small storm runoff and erosion may be eliminated. The practice improves soil drainage and aeration, decreasing the potential for denitrification. This may result in nitrates being leached deeper into the soil. The plant roots are able to go deeper so the nitrates may still be taken up by the plants. The time of year and extent of plant growth will need to be considered.

In rainfall deficient areas, subsoiling may bring salts and toxic materials to the surface or into the root zone, thus making these materials available to plants or subject to being relocated by erosion forces.

The poor physical conditions of a sodic soil may be ameliorated by subsoiling, which may bring calcium salts up into the surface horizons.

1. Effects of slope and direction of tillage on sediment delivery to surface water.
2. Effects of the erosion and the movement of sediment, pathogens, and soluble and sediment-attached substances carried by runoff.
3. Potential for development of saline seeps or other salinity problems resulting from increased infiltration near restrictive layers.

## **PLANS AND SPECIFICATIONS**

Specifications for establishment and operation of this practice shall be prepared for each field or treatment unit according to the Criteria, Considerations and Operations & Maintenance described in this standard.

## **OPERATION AND MAINTENANCE**

Deep tillage for reduction of soil compaction shall be performed whenever compaction reoccurs.

When deep tillage has been performed to reduce the concentration of soil contaminants, the contaminate levels in the root zone shall be monitored to assist with determining when or if treatment will be reapplied.